

The Guide to Materials & Products

Consumer Awareness in Landscape Lighting

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The Experiential Landscape Lighting Initiative
www.landscapelightinginitiative.org

Material & Product Awareness

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INTRODUCTION

This Guide is a professional approach to providing trade insights and simplified information to the consumer market. Currently, the lighting industry, as well as the landscape lighting trade has not properly addressed how to do this. The consumer needs access to easy-to-understand information. This aspect alone is a huge disservice to the public.

The **Experiential Landscape Lighting Initiative (ELLI)** is a consumer-friendly, educational provider, which exists to ensure the understanding and importance of good landscape lighting. Its goal is to provide information, and to provide a means to measure good from bad and right from wrong.

Unfortunately, what has been the general practice to educate the public has been poor. The current offering of educational materials is either too comprehensive or too basic and lacking necessary detail. Therefore, this leaves the consumer confused and/or misguided. The public let alone the tradesperson wants to spend extra time trying to figure it all out. This is where ELLI comes in, as a resource to all parties.

This Guide is one of a series to provide information on the **Materials and Products** utilized in the landscape lighting profession. It should serve the consumer with a means to understand and to compare what is being offered by each service provider. This offering of information will allow the consumer the ability to make the best decision with regards to Quality, Cost, and Concerns associated with materials.

The goal here is to “raise the bar” on this type of work. This will naturally occur as more and more people begin to understand the differences involved with this practice. It will erode the base of poor performing providers, as it should for the betterment of the public. It will liken itself with the ‘Natural Selection’ process—the weak or poor providers will be overcome by the strong. The benefits in this process are: 1) better lighting designs, 2) better performing lighting systems, and 3) better performing professionals.

Please visit the **Experiential Landscape Lighting Initiative (ELLI)** website for more educational content at: <https://www.landscapelightinginitiative.org>.

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PURPOSE OF THIS GUIDE

The primary purpose of this Guide is **to educate and inform** the public or consumer about the varying materials used in the product selection of landscape lighting systems. Many contractors and specifiers have taken advantage of the consumer, because of their lack of knowledge. Therefore, this guide is intended as an aid to correct this.

Another important purpose of this guide is to offer enough information **to ‘measure’** the landscape lighting designer and/or installer (contractor). If the consumer understands what is acceptable and what is considered the higher level of quality, then they can effectively maneuver between provider offerings. This act alone will raise the bar for bettering service providers. This is the end-goal with the ELLI provisions.

Without knowledge and awareness, the consumer is left only to rely on the service provider’s word. This is or can be a big risk. Can you afford to “trust” any unknown service provider?

The consumer needs to know that the materials used on a project is an opportunity to take advantage of them. This is the truth, and many do. This Guide will Not provide a breakdown of product brands, nor will it recommend brands because there are too many available in the market. However, it will provide a means to determine what is best for you (the consumer).

It should be known that most experienced providers/companies do offer better quality of materials. This is Not 100% true, but the average shows this to be the case. The reasoning here is that it is likely these experienced providers would not still be in business if they were working with poor products. Are these products and materials considered, the best or top-of-the-line, that is questionable by some? Again, this guide should aid the consumer enough to protect themselves in this matter.

QUALITY

Quality is a broad term and it is defined in a couple of ways:

“The standard of something as measured against other items of a similar kind”

“A distinctive attribute or characteristic possessed by someone or something”

It is for this reason that we must better identify what it truly means in the landscape lighting realm. Let’s first identify the various materials used in this profession, and then move to determine what is the most appropriate end-result for your needs.

Quality can be in the form of ‘longevity’ and ‘durability’. Both serve as a form of measure. **Longevity** is the ‘life’ of a lighting system and applied to the individual components thereof. How long do you wish to have this lighting system last? How well do you wish it to look as it did when it was first installed? Is it a short-term investment or long-term one? **Durability** is the other factor and it relates directly with the quality of materials used. Poor or lesser-grade products do not withstand the elements or physical impact. Some products deteriorate or corrode, due to the extreme exposures of these environments.

Performance is another measure which separates materials and products. This can vary greatly, as there are many types and models available to choose from. Consumer selection is dependent on individual constraints or needs and desires.

Performance of the lighting system are most affected by the materials used, and how they are employed. Service providers do Not follow one set of standards, so this can vary greatly, and it could impact the longevity of the system. The following are examples:

- **Cable Size and Type**—There are varying cable sizes and types that are used/can be used. Most consumers have no idea what is acceptable, or common practice.
- **Cable Protection**—There are varying ways to protect cable within the landscape. Very few use PVC conduit as an added measure of protection, but this would be the best application. Other practices would include running cables adjacent to hardscape elements that are buried well enough.
- **Cable Distribution**—Although this is primarily considered a design application (by the service provider), it can be related to the cable size(s) incorporated into the design. An improper design layout can impact performance, and this is due to a physical attribute called, ‘voltage-drop’. The electrical load on each cable run should be understood, so that the voltage drop is controlled within the lighting system.
- **Construction of Products & Equipment**—There are several types of construction materials used in the establishment of light fixtures and equipment. These can be made primarily of metal or plastics.

The above listed examples are further explained or defined in the following content.

Quality costs money—this is the only way to say it. If the consumer has the choice, they will always want the best quality. However, many cannot afford the higher prices associated with this level of quality. It’s the consumers decision to decide how much they can honestly afford to spend for this measure. Higher quality always relates to better performance and longer life.

MATERIALS & PRODUCTS

The materials and equipment required to establish a functioning landscape lighting project vary quite a bit. The competition by suppliers is great. So, the challenge is in finding the best products available at your available budget range. There are a couple of ways to do this:

1. **Consumer spends the time to research what's best for them**—this can be very time consuming and it can be overwhelming. A question should be asked, “Do I have this time to properly perform this search?” You might also ask, “Do I have enough knowledge to know what is right for me?”
2. **Consumer does limited amount of preliminary research**—this is usually the best solution, because you can learn more in the process and protect yourself against those looking to take advantage of you.
3. **Consumer allows lighting designer-contractor to determine what is best**—this is the easiest and fastest way to get things done, but you are at the mercy of the designer-contractor to provide you good options. You will have to rely on their experience and trust their choice(s). If you have the wrong service provider or one with little experience, this can lead to big problems later.

It should be noted that the average cost of materials for the job range from 45% to 60%. Material costs are usually the most expensive aspect of any project. Therefore, this is the preferred cost area to cut, when trying to make a budget work. The second likely cost area to cut is in Labor. Typically, labor costs range from 15% to 35% of the job, and this is a broad range. Overhead costs are usually part of the labor factor, so don't just think that the service provider is making big dollars when they have a crew and operations to manage.

There is one big consideration to remember when understanding products and materials, as associated with landscape lighting—they are installed in the harshest of conditions. **Outdoor environments are extreme conditions**—they must endure the sun, UV exposure, chemical exposure, temperature extremes, moisture/water/ice, and physical contact with humans, animals and nature. Interior environments are no comparison.

Transformers

A transformer is nothing more than an electrical device to convert alternating current (AC power) from one voltage to another. A transformer is also called a ‘converter.’ In the case of low voltage, landscape lighting, it converts 120-volt power down to 12-volts at a 10:1 ratio.

The most important consideration of any transformer is its safety. The consumer should be the most concerned about this because these units are installed on their property and

there's always a potential for electrical failure, fires, etc. It is for this reason that we have codes, listings, and ratings on all equipment and products sold in the USA.

As far as outdoor, landscape lighting is concerned, transformers should be compliant to the safety ratings and listings required for "outdoor use". There are two listings that transformers or landscape lighting systems fall under: **UL1838** and **UL2108**. These will be found on the label inside the transformer.

What is a safety 'Listing'? It means that an independent third party has tested the product to a nationally recognized safety Standard and has been found to be free from reasonably foreseeable risk of fire, electric shock and related hazards. There are several nationally recognized safety testing companies that perform these safety test to the listed Standards. The most prominent one's are Underwriter's Laboratory (UL) and Electrical Testing's Laboratories (ETL).

So, in the Standards shown above, they are UL1838 and UL2108, which are a series of specific tests that the product undergoes to ensure they endure or meet this Standard effectively.

Note: It is interesting and somewhat disappointing to see that there rarely is the word, "Approved" used by those heading up safety. They avoid its use and make the manufacturer responsible in ensuring safety. While UL and other agencies have taken this stance, they are now less prescriptive about how products are designed and are more concerned with 'hazard-based' use cases. This means that manufacturers must identify how the component or product might present a hazard in its intended application, declare it, and test accordingly.

Realistically, the consumer should not be expected to know or to worry about the various safety requirements or codes—this is the service provider's responsibility. Therefore, the consumer needs to hire those that are licensed contractors and know this work. "Buyer Beware" to those who choose to hire a 'handyman' or someone who is not 'licensed' for the sole purpose of trying to save a few dollars.

You are dealing with ELECTRICITY—is it worth the risk of starting a fire by using someone who doesn't understand how to properly install these systems?

There are several types of transformers available. All that needs to be considered is the following:

1. **Safety**—is it properly listed to the necessary Standard, as described above?
2. **Correct Size**—is it able to handle the electrical load for the lighting design plus at least 20% more? The added 20% is established as a cushion in case more lights are added to the system, or in the case of long-length cable runs.

Typically, low voltage (12-volt) transformers can range in output from 50-watts to 1200-watts. Additionally, they can also provide from 11-volts to 15-volts, under these listed ratings. There are other professional transformers that are used, which are outside of this safety listing, and they extend this output to 22-volts.

3. **Capability**—can the transformer provide enough power to maintain the proper voltage at the furthest light fixtures. This can be a design application, as well. Long distances and too many fixtures can impact this voltage (in voltage drop). It is the contractor’s job to know what these units are capable of.

Note: This could be a test or measure to ensure the contractor is doing the right thing. If you are concerned about performance, then you might consider asking the contractor to prove what this voltage reading is at these furthest light fixtures. In fact, this will likely catch him/her off-guard—99.9% of the consumers will never ask or even consider this.

The industry provides single, dual, and multi-tap outputs for most transformers available in the market. Single output models (**‘single-tap’**) provide only one level of voltage to connect to. Dual output (**‘dual-tap’**) units provide two different levels of output. Most lighting kits or those purchased from the hardware store or big-box store provide these units—they are lower in cost and are limited in both range (distance) and load (wattage). Typically, these units are utilized by the Do-It-Yourselfer (DIY) enthusiast.

‘Multi-tap’ output transformers are identified by having 3 or more low voltage outputs. These outputs or “taps” are usually labelled from 11-volts up to 22-volts. These units are normally used by the professional lighting contractor, although they are available to the public. Care must be taken in using them, because those with little to no experience with them can cause potential problems, failures or even fires with them.

Each of these transformers has its place in the lighting world—it all depends on how, when and where to use them. It is for this reason why one should have a detailed lighting design or plan, which identifies these electrical loads. This will be discussed more in the **Consumer Guide for Services & Service Providers**.

Lastly, the cost associated with a transformer is relevant to the size and features of the unit purchased. Stainless steel units are the most commonly used models for the trade professional. Steel or plastic models are the cheapest.

Transformer Construction

As far as the material (metal) used on the transformer casing (outer shell), there are a few types found:

- **Stainless Steel**—this is the best and most commonly used. It is ideal to protect against corrosion and the outdoor elements. It is the more costly option of all the transformers, but well worth it.

- **Steel or Aluminum**—although these aren't used much by the pros, they are prevalent. They usually have a painted finish on them to provide a protective coating against the environment. But, if this coating gets chipped or compromised, then it allows oxidation and its corrosive action to attack the underlying metal. Once this occurs, then it's a matter of time before it eats away and falls apart.
- **Plastic**—these are typically found and used at the consumer level when shopping the hardware stores. They are low-cost units which support only the single and dual output models. Most of these plastics become brittle over time, discolor and eventually break apart when exposed to the UV rays of the sun.

Light Fixtures

Most consumers are familiar with some sort of light fixture used in landscape lighting—usually the path light or the up light (spot/flood light). The 'fixture' is the whole unit, which includes the outer protective housing/structure and the inner lamp/LED light source. Hundreds and hundreds are available to the market. Examples include; 'path lights', 'up lights', 'down lights', 'wall lights', 'deck or fence lights', etc. It is very common for service providers to show you these samples, so that selections can be made.

Most service providers will show you a sample or samples of the light fixtures to be used on the project. Again, there are so many different brands, most of which are provide the same types of fixtures. The only difference between brands is in the quality of materials they use in their construction, and the features or components within them, which make them better or worse. Consumers should ask to see which fixtures are suggested to use, and why they are practical for this use. The consumer needs to inspect or at the least, understand the construction of these products. The following are elements to look for in measuring the differences between product brands:

- What **type of material(s)** are used in the construction of these units? How thick is the material being used? Is it thinner sheet-type metal or spun metal, or thicker cast metal?
- How **stable** and/or **durable** are the assemblies? Many of the light fixtures have multiple parts attached together—these can be weak points. The taller the fixture (height or length), the weaker it becomes unless it is offset by thickness. And one should consider the stake attachment to this assembly.
- What **type of ground stake** is being used to support these fixtures? Most manufacturers supply a plastic (composite) stake. These are fine for basic use, but they are susceptible to breakage with physical impact. Some vendors provide brass or stainless-steel stakes and these are much more durable. However, they cost more.

- How protected is the **light source** (LED or lamp) from the exterior environment? Most manufacturers enclose the lamp/LED compartment, but some just cover part of it. Most LED's fail when they are directly exposed to water sources or excessive moisture. Additionally, open compartments allow insects and debris to gather inside, which can be problematic over time.
- How is the **glass lens adhered** to the fixture top, hat or face? Depending on the fixture type, this can vary. The most important consideration is that the glass lensing is adhered and sealed against water and particle intrusion. Some manufacturers use a compression fit method, as a means in holding the lens in place. Although this method works (sometimes), it is not 100% guaranteed against water intrusion. Other manufacturers silicone the glass directly into a fitting or the fixture housing components.
- How is the **knuckle assembly connected**, if it's used on the fixture? Most use a thumb-type screw to adjust these positions in aiming. Some use a hex screw. It's more of a matter of preference, but it's better to have the head of the exposed screw larger versus smaller. They are easier to work with. Also, larger diameter screws and bolts are better because they are less likely to break.
- How does the **lens cap attach** to the fixture body? Some products are threaded assemblies, some are compression fit over O-rings, and others just slide on and are held in place by a lock-down screw. The threaded and compression fit types are the best, whereas the slip-on types are poor. Both the threaded types and the O-ring types should be lubricated. This will ensure they function over time, as the threaded types tend to cease-up, and the O-ring types tend to dry out and shrink. And lastly, the O-rings should be made of 100% silicone (they are colored orange to orange-red)—many manufacturers use a cheaper grade of O-ring, which can fail early (these are typically black in color).
- What size (gauge) and **type of wire/cable is used as the wire lead**? Wire leads are the short wires feeding out of the light fixture from the lamp/LED compartment. Usually, these are smaller in gauge size from 16-ga. to 22-ga. The higher quality of fixtures will use a larger size (16-ga. or 18-ga.), and these wires will be rated for high temperature use. The size & type can impact the operational efficiency of the lighting fixture. Lower quality brands will use smaller and lower heat rated wiring to save money.

As far as the materials used for the construction and assembly of light fixtures, you have the following:

- **Brass**—this is one of the best metals to work with in an outdoor lighting system, because it essentially holds up for the life of the system. Realistically, it will hold up longer than we are alive! It ages extremely well, and it is durable. It is stronger than copper. Brass is usually a higher cost product.

- **Copper**—this is another excellent metal to work with for outdoor considerations. It is long lived, just as brass. It ages very well and patinas (oxides and turns colors) with time—you'll see earthy colors, greens, blues, or even reds on the copper. This metal is softer than brass. Copper is a higher cost product.
- **Stainless Steel**—this is a very good metal of outdoor use and you find it used on many items. It is less frequently used in fixture construction, and it is harder to find. It might dull down some with time and doesn't look as good as the brass or copper. Stainless steel is a relatively high cost item.
- **Aluminum**—this is a great metal to work with, as it is easy to obtain, fabricate, and it's lighter in weight. The cost for aluminum is typically less costly than the brass or copper, but it is more susceptible to corrosive deterioration than the previous metals. The use of aluminum in the exterior environment can be best protected if it is pre-treated with chemicals. Some manufacturers administer a chromate conversion bath in order to seal the aluminum before it is painted (powder coated). Additional protection can take place in the powder coating process. However, many lesser quality manufacturers do not perform these steps.
- **Plastic/Composite**—these products are harder to find these days, but they are still available by the poor-quality brands. Most plastics or composites deteriorate over time, due to the UV exposure of the sun. These products are less costly, and it's because they do not last as long. The consumer should consider these products as, disposable.

Cable & Connectors

Many do not consider the electrical cable and its connections to be that important. However, these are the most important applications of in the lighting system. Poor connections and improper wiring techniques are the most frequent problem found in failing systems. Therefore, the consumer should understand and insist on the use of solid, high performing connectors—those which are mechanical in function and those which are 100% waterproof.

Cable is a term used for an insulated wire or wires having a protective casing (sheathing). These cables transmit electricity from the transformer to each light fixture. There are two types of cable: solid and stranded. The majority of low voltage landscape lighting cable is stranded. Stranded cable uses a series of smaller sized copper wires wound together and protected by an elastomeric jacket (sheathing). In the case of landscape lighting, a set of two conductors is placed side-by-side and separated by the sheathing within one cable. It has a two-digit number designator, which identifies the gauge size of the conductors, and the number of conductors within the sheathing. For example, the designator "12/2", identifies that each conductor is (12-ga.) in size and there are "2" conductors within the cable.

The larger the conductor size, the smaller the designator number is. For example, 8-ga. is larger in diameter than a 12-ga. size. The common sizes used in landscape lighting systems range from 8-ga. to 18-ga. Most professional service providers work with 12-ga. as a primary workhorse cable feeding all lighting zones. Larger sized cable can and should be used for longer distances. Some providers use a smaller gauge size (14-ga or 16-ga.) to individual lights at close distance to the transformer or for certain runs between fixtures. This is all dependent on the lighting design layout, and what the electrical load limitations are. Utilizing the wrong size cable can impact performance.

It is always better and more efficient on the lighting system to use the larger sized cable. This will limit or avoid potential over-heating issues and over-loads. An experienced lighting designer will know how to calculate loads so that they are safe.

NOTE: many service providers believe there is little to no need to calculate loads on the lighting system design, because most are using LED light sources. Although these LED's have helped to make operations easier, these lighting systems still need to be safe. The old principles still apply when performing electrical calculations, where Ohm's law matters, as does voltage drop.

Connectors or Connections are the essential component of the lighting system. They ensure that all cable is securely connected. Poor connections provide resistance and over-heating. These can be problematic and even dangerous, as they can potentially melt down the cable sheathing and ignite dried debris near it—in other words, start a fire. They also can fail and cause fixtures to stop functioning. Many service providers utilize low-cost, cheaper connectors, because they don't understand this importance. Additionally, most of the landscape lighting distributors sell lesser grade products, as that seems to be the standard. Be aware and ask the provider what type of connector they use.

The best connector types are those which provide a mechanical form of connection. The poorer ones use a piercing-type of connector or the silicone-filled types. Although these work in the beginning, they do loosen by heat expansion over time and if they are not tight or solid, they will fail. The following are the best types of connectors:

- **Mechanical lugs with set screws**—these are barrel-shaped, metal tube-sleeves made of brass, copper or aluminum. They have one or two set screws at each end to tighten/torque down onto each conductor end, thereby solidly attaching each cable to one another. Once completed, they are sealed by heat onto and around the connector and cable.
- **Mechanical lugs that are crimped**—these are the same style of lugs as described above, but without set screws. Instead, they are crimped onto each cable end with a special crimping tool. The same sealing/waterproofing method occurs once crimped.
- **Solder-type**—this is more of a method of connection, which uses a metal solder that is heated up into a liquid form and then quickly solidifies the conductors

together or to another metal piece, so that a connection is made. This method is more time consuming and requires extra equipment—this is a deterrent for most and the other methods are preferred.

It is very important to seal each cable and connection from the intrusion of water. Water can cause a chemical reaction (corrosion) to the copper wiring if not properly protected. This action can impact the efficiency of the lighting system, because there is more resistance in the electrical path. In most cases, this will also cause the copper cables to become more brittle, and this can lead to breakage in copper strands when disturbed.

To ensure system performance, **waterproofing** must take place. There are a couple of ways to provide this measure of protection:

- **Heat-shrink application**—there are products available, some better than others, which utilize poly-type tubing that has adhesive on the inside. These are placed over the cable and connector, then heat is applied in order to “shrink” the poly tube onto the cable and seal it. This is one of the best methods to keeping water out. These components are a little more costly than the other methods.
- **Chemical application**—there are products designed to chemically seal off these connections. These are normally painted onto the areas to protect, such as the connector itself and the exposed copper exiting the sheathing of the cable. This is an effective and low-cost approach, but care must be taken to ensure everything is evenly coated. It is a riskier method over the heat-shrink. Also, most of these chemicals are toxic and can cause health hazards.
- **Solder application**—soldering or tinning connectors and exposed wiring can be very effective, but again, care must be taken to ensure all parts are covered against exposure. It’s not as expensive as the others, but it’s more time consuming and cumbersome.

Light Sources (LED’s & Lamps)

The lamp or LED is the actual light source used inside a fixture housing to provide light. Many consumers find this confusing because there are so many variables associated with lamp/LED selection. Don’t feel bad, because many service providers are confused as well. I say this mostly in the case of those who provide landscape lighting, but realistically have little training and education in this field. This can be the landscaper, pool builder, fencing company, etc., they all do lighting as an “add-on” component to their work. However, the ‘red-flag’ of awareness should raise up because these providers will only give you a basic and simple approach to their lighting designs.

Additionally, there are hundreds of brands selling these lighting sources—this is overwhelming and only adds to the confusion. Regardless, as a consumer you should place your attention on finding the most experienced lighting designer you can that Does

understand these variables. We will not address all the details here, rather we will address what's type of lamp or LED you might work with.

Let's first understand the difference between the landscape lighting options commonly worked with: 1) Light Emitting Diode (LED) and 2) Incandescent (the older, original form of light). This is the easiest way to differentiate between what's available. The following breakdown these two source types for better understanding.

Incandescent is now considered, "old-school," but they are still used on many lighting systems today. Some prefer it, and others just don't wish to change. The only benefit to the older technology is the color or warmth of the light. However, most of the LED technology has caught up to developing this same color rendering. Incandescent lamps, including halogen models will typically have a color temperature range between 2700K-3400K (color temperature in Kelvin)—this is the "warm" white color that most appreciate. It's slightly an amber colored, white light.

Halogen lamps are incandescent sources of light, as well as Xenon lamps. Manufacturers developed them to last longer than the standard Tungsten filament lamp by added one of these gases inside the glass bulb.

LED's can be found in the form of a "Retrofit" or "Integrated" style. Each are good products, but they offer different advantages. The advantage differences relate mostly to protection against water intrusion and heat dissipation. Each of these issues are problematic or killers against LED's functioning properly. Life expectancy can be shortened if the associated heat build up within and around the LED unit is not transferred away from it. Additionally, water and moisture can damage the electronics or corrode these components. Each of these is important to consider and these units must be protected.

Retrofit LED's are less costly and are limited in performance output. They have a higher susceptibility to failure to water and heat, as explained above. However, they are excellent options for retrofitting existing landscape lighting systems which used the older light source technologies. And, they provide an immediate return on energy use.

The key to success with the retrofit LED is to ensure that you use a higher quality light fixture, which effectively seals and keeps moisture out. Additionally, one should select fixtures that allow for good heat transfer. Unfortunately, many of the older fixture models were not designed well to transfer heat away from the lamp source. There's not much you can do about this when you are working with existing system, so the consumer just needs to understand that they will likely loose 'life' on these LED's units—see the following example:

I typically tell customers to expect only 1/2 of the listed rating on these retrofit LED's. If it's rated at 50,000-hrs., expect it to function closer to 25,000-hrs. This allows for an increased depreciation or life, due to primarily to excessive heat at the LED. And, it should be noted that 25,000-hrs. is still a long time. It makes

perfect sense to make the switch to them because you will receive an immediate ROI on energy savings, due to it's ability to reduce wattage consumption by about 80%.

Note: Each year improvements are made in technology. The market has yet to stabilize in this growth/advancement, so I believe the retrofit solution is a preferred option.

Another item to consider with retrofit LED's is that they are limited in lumen output. This means they can only provide so much light output. Currently, this is around the 6 to 7-watt range. The industry is and has made higher output models, but they have found that there are more problems and failures associated with retrofits at these higher values. This is due to the heat production inside the fixture housing, especially when using older style light fixtures. Remember, excessive heat can kill the LED.

Integrated LED's are the more costly light source of the group. They are the best option against water intrusion, and they are the best option to dissipate heat. These units are fully potted, which means they are 100% sealed.

Also, because these integrated LED's are specifically designed into the light fixture, they properly transfer heat away from the critical components of this light source. These integrated designs effectively allow the light source to operate at a cooler temperature. This is the second advantage to using these types of LED's.

There are two disadvantages in using integrated LED's. First, they cost more than the other options, and second, this current technology is likely to change with time, which means they could be discontinued. The lighting industry is still in a state of growth, so technology is ever-changing. If these products are touted to have a life expectancy of 15 to 25 years and they discontinue the model in 2 years, what do you do? This can be very problematic if you are trying to match fixtures or match color temperatures.

For example, you buy a job full of light fixtures in 2017 and the manufacturer decides to upgrade and offer the next generation of technology. They discontinue these older models and you no longer can get the same one's you have. Then, you have one or more fixtures either fail or get damaged, which you must replace the whole unit. At this point you only have two options: 1) to utilize a different model, or 2) to go without. This is not good, and it's already happened to consumers.

Additionally, will you be able to find the same exact color temperature as what you currently have? It's hard to say, but likely not. Fortunately, the light seen with most landscape lighting is difficult to see subtle variances in this color temperature. But, if these lights are on a illuminating a wall of a home, then it's much easier to see these color differences.

There are a few other things that might aid the Consumer in understanding the differences between products:

- **Voltage**—is the electromotive force used in the lighting system. Typically, we get electricity from a household receptacle (outlet) and it supplies about 120-volts to most all appliances. In turn, this electricity is “converted” from 120-volts down to 12-volts within the ‘transformer’.

Lamps and LED’s operate within a small range of voltage. The incandescent lamp normally operates best between 11 to 12-volts at each individual lamp source on the system. LED’s have a broader operating range from 8 to 25-volts. However, optimum performance with any light source on a 12-volt lighting system is at or as near as you can to 12-volts at each lamp source.

- **Wattage**—is a measure of electrical power that is used to produce a specified lumen output (amount of light). With LED sources, you’ll find that each watt correlates to the lumen output. For example, if we have a 4-watt LED that provides 240-lumens, then that equates to 60-lumens/watt. You’ll find these types of measures or ratings on the LED box it comes in.

Note: As a reference or comparison, if you take an old-style, 20-watt, halogen lamp, it would be roughly equivalent to a 4-watt LED unit.

- **Lumen Output**—is a measure of the total amount of visible light from the light source. It is also known as, brightness. The higher the lumen rating, the brighter the LED or lamp will appear.
- **Color Temperature**—is a measure of the color of the light source. We won’t go into the details or science behind this, but just know that ‘white’ light can have a broad range of coloring. Some are “Warmer” in color and appear to have more yellow, amber, or orange in them. “Cooler” white lights will appear to have more green or blue associated with them. All color temperature is measure in Kelvin (K).

“Warm” white colors will range from 2000K to 3000K, “Neutral” white colors from 4000K to 5000K, and “Cool” white colors from 5000K and above. The most common “warm” white colors available for landscape lighting are 2700K and 3000K. The most common “cool” white color is around 5700K.

- **Beam Spread**—is the approximate distribution of light measured in degrees from a light source. It is the amount of space a light pattern covers at varying distances. The beam spread can also be a measure of intensity.

Terms are used to describe the beam spread and include: ‘Spot’ (4 to 19-degrees), ‘Flood’ (20 to 35-degrees), ‘Wide Flood’ (36 to 49-degrees), ‘Very Wide Flood’ (50 to 120-degrees or more). The most common LED beam spreads found are 15-deg., 30-deg., 60-deg., and 120-deg.

The wider the distribution or spread of light, the less intense it is. So, if a desired amount of light is to be softer, then a 60 or 120-degree source might be best to apply.

- **Lamp Life**—is a measure usually in ‘hours’ where the lamp fails, or the LED reaches a declining state which is determined to be noticeable. With the older lamps (incandescent types), the tests would give a ‘life’ rating to the lamp type when 1/2 of the test batch burned out.

LED’s use a different set of testing, and after about 6000-hours of running them, they extrapolate the results over time until 30% or more of their lumen output has depreciated. This is where they arrive at a ‘life’ rating for them.

Control Devices

There are many different types of controls available which function to control the landscape lighting system’s on and off times. In fact, there are too many to properly discuss here, so we will just focus on some of the basic controls—those that have been around for some time.

Control devices can operate with the use of a daily time schedule, the amount of light daylight present, or manually by a switch. The following are the simplest forms of control devices and how they function:

- **Time (Timers)**—Timers operate by electricity, which is usually the 120-volt power supplied to the transformer. This can be from within the transformer itself or at a separate outlet at its receptacle box. Timers can be ‘**mechanical**’ or ‘**digital**’, and they function on a 24-hr. clock schedule.

The timer functions to turn ‘on’ and ‘off’ the lighting system. Some allow you to establish several on & off times.

The advantage to these forms of control are that they are relatively inexpensive. The disadvantages are that if the power goes out, then you must reset the timer to the current time of day. However, most digital timers have a battery back-up, which allow you to keep your programed times stored during power outages.

- **Light (Photoelectric Devices)**—Photoelectric devices operate like a switch and function by the amount of daylight available to the device. These devices are photosensitive. They are known as ‘light sensors’ or ‘photocells’ because they convert light energy into electricity. They are dependable but do diminish with age, and therefore, must be replaced.

Most photocell units are used in combination with a timer, because the timer allows for the photocell to be deactivated at a desired time. For example, the photocell will typically operate from dusk to dawn each day, so the timer is

programmed to turn ‘on’ before dusk (throughout the year) and then, shuts ‘off’ at a scheduled time. This will occur every night.

Note: Even though the timer is set to engage prior to the photocell’s functioning, it will not turn ‘on’ the lighting system until there is enough darkness present.

- **Radio Waves (Wireless Devices)**— There are alternate forms of control devices which utilize wireless technologies, such as **WiFi** and **Bluetooth**. They both take advantage of allowing the customer to use their phone, smart phone, and computer to transmit information by radio frequency (RF). Both are relatively easy to use, but reliability can vary, based on distance. Communication networks can vary in range around the home, so this is the limitation in these types of systems. Typically, a signal receiving device is located at the transformer location and communicates back to the network equipment.

The disadvantage in using these systems is all based on range. In addition, the costs associated with these devices can be more costly than the other types.

- **Wired Systems**—These systems, as stated, operate by direct cable feeds. The only way a system can fail is by the cabling being physically compromised or cut. They are the most reliable of all systems, if you have electricity (power).

Most of these systems function electrically through a relay form of switching. Typically, these systems cost more primarily due to the labor to install them.

- **Manual operations (Switches)**—These are physical switches which are manually turned ‘on’ and ‘off.’ They can function at the transformer location, where the transformer and the entire lighting system is turned on and off, or they can be isolated within the lighting system and on the 12-volt (low voltage side).

They are extremely dependable, easy to operate, and very low cost, but the disadvantage is that you have to go out to these locations and physically turn them on or off every time you wish to use them.

Manufacturer Location

Where are the products made? Are they made in the USA or in some other country, which imports them in? This may not be a huge concern, but it is something to consider. Many of today’s landscape lighting products are made overseas, most likely in China, Taiwan, or Mexico.

Currently, tariffs are being enacted to provide fairness to the USA companies, which struggle to compete against these lower cost markets. This will have a deep impact on those importing these products—costs are likely to increase. In addition, many manufacturers are or will discontinue certain models. It is for these reasons—be aware

and consider whether or not you wish to deal with this down the road. You may wish to add more light fixtures. You may have damages and need replacements.

There are three areas of concern when dealing with companies located overseas:

- **Quality and Quality Control**—Many companies outside of the USA don't prioritize this aspect on products, because most products are made quickly and cheaply. Most of these countries are paying their workers extremely low wages. All they care about is 'selling' the products, and getting them out the door.
- **Warranty**—Most do not realize that these overseas companies may not provide any warranty, because they do Not want any returns. Instead, they might credit the buyer/supplier for poor products returned to them. Those supplying these products end up carrying the warranty to the consumer. As a consumer, you need to understand who is providing what warranty.

Typically, the contractor (installer) has only a 'workmanship' warranty...on the work they do. Products and materials have their own, separate warranty. These warranties are provided by the manufacturer and/or distributor. As with any of them, read the fine-print on what is an acceptable return or claim against the warranty.

- **Production Delays**—Although this may not directly impact the consumer, it can be problematic. What one might experience is the USA supplier will be delayed on a shipment, which impacts the consumers ability to get product on time or when needed. This is more readily occurring by overseas manufacturers vs. USA companies.